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(54) Abstract Title
**Closing car windows : anti-pinching system**

(57) A car door window frame 12, towards which a window pane rises, carries a light guide 14, e.g. an optic fibre, in a cover 15 or in the frame covering 13. A member trapped by the rising pane presses the guide and thus restricts the quantity of light conducted, which restriction is sensed to stop or reverse the window motor. Every time the pane is raised the system detects a value of light conductivity of the guide as a reference value. The guide may be looped backwards and forwards through incisions across the cover (Figures 3 and 4, not shown), which is said to allow easier pressure detection.

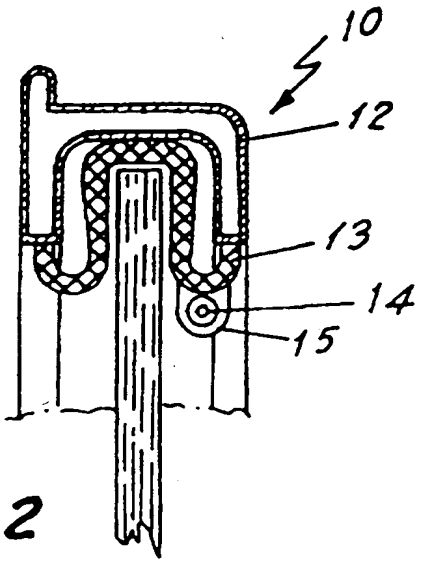


FIG.2

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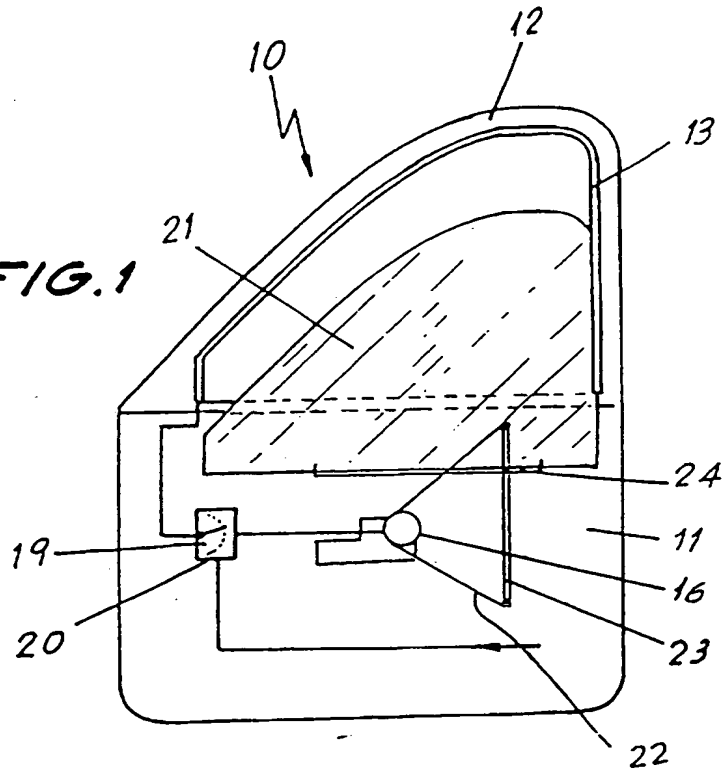


FIG. 1

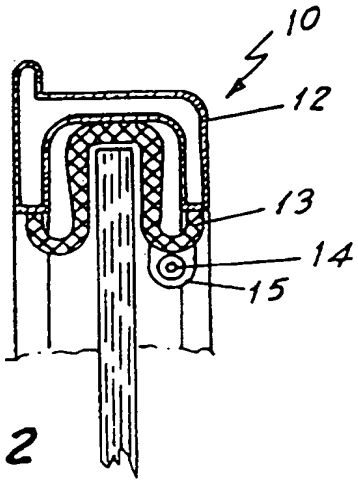


FIG. 2

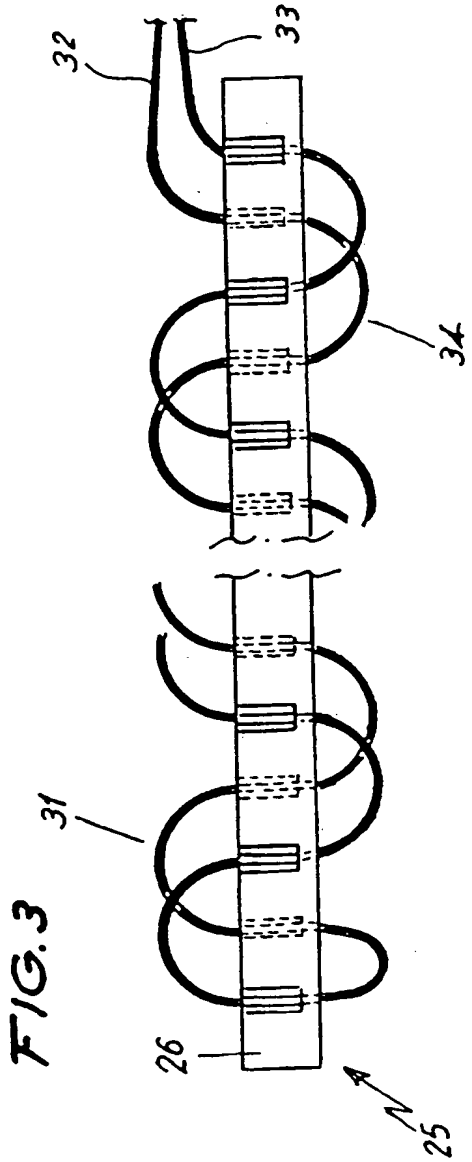


FIG. 3

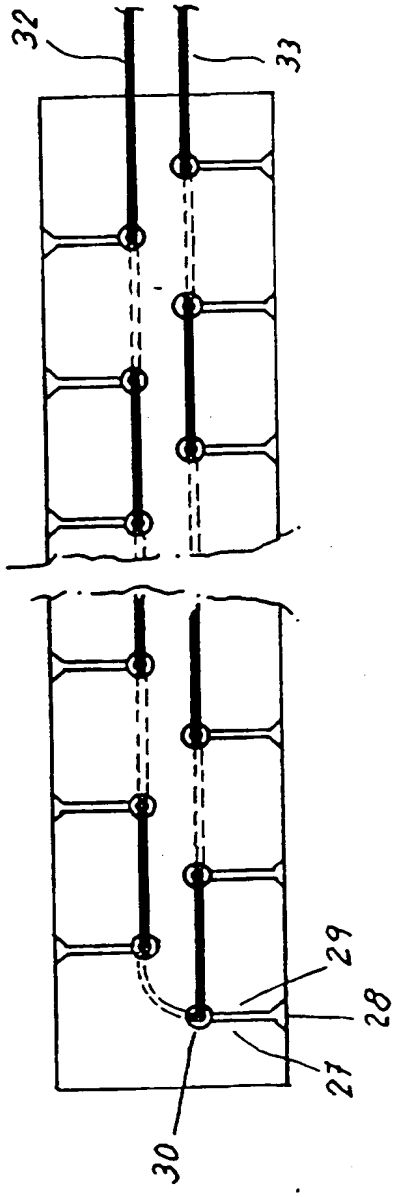


FIG. 4

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# ANTI-PINCHING SYSTEM

The present invention relates to an anti-pinching system, and especially to such a system based on modification of the light conductivity of an optical fibre or other light guide, for example for automatic car windows.

The invention relates more specifically to a new anti-pinching system using a light transmission means to detect obstacles between the perimeter of the car window and the frame of the door.

A number of systems exist on the market, which are capable of detecting an obstacle when a car window ascends in its frame in response to actuation by the user of the window control button.

These prior systems may be divided into two broad groups, direct systems and indirect systems. The first group consists of sensors which, owing to their sensitivity, permit direct detection of an obstacle and send an appropriate signal to the electric motor whose role it is to actuate the various components involved in raising the window, in such a way that the motor is stopped and its operation is reversed, such that the window descends.

The indirect systems analyse the operation of the motor in such a way that, when the window encounters an obstacle, a variation is produced in the current circulating through the electric motor or a modification is produced in the speed of rotation thereof, which is detected by the appropriate sensors incorporated in the electric motor. Through this variation in current or speed, the system detects the presence of an obstacle between the window and its frame, causing the motor to stop and reverse its direction of rotation.

Although the above systems represent considerable progress with respect to early arrangements which did not provide any anti-pinching or obstacle-detection systems, they exhibit severe limitations. The prior systems are subject to frequent breakdowns and in some cases they interpret modifications in the environment in which the window is displaced as obstacles. For example, hardening of the guideways or the rubber seals disposed in the door frame in many cases cause an increase in the resistance encountered by the window as it ascends in the frame, which the sensors interpret as the unexpected presence of obstacles, such that they stop the motor and reverse its rotation, obliging the user to return to the dealer so that the problem can be solved by reprogramming the various systems.

The above-described systems are, in many cases, incapable of sensing pinching at the sides, that is to say not only pinching which occurs between the upper part or edge of the window and the frame but also pinching which occurs between the side edges of the window and the side frames thereof. This is something which may happen with the rear windows in many car models and may cause serious injury to persons. This situation has been amply described in publications and journals relating to the industry.

The gravity of the above-described problems has caused even the authorities of the European Union to publish appropriate standards to ensure that the force with which automatic windows are raised does not exceed critical values since, if this is not the case, such windows may cause very serious injuries to fingers, arms, the neck and other parts of the body which may become trapped between the upper or side edges of the window and those of the door frames or structures covering the latter.

The present invention relates to an anti-pinching system, especially for automatic car windows, which is capable of overcoming the above disadvantages in that it is capable of detecting obstacles directly by means of a light sensor disposed along the entire length of the window frame, the operation of which light sensor is based on the arrangement of a light guide such as an optical fibre conductor around the entire perimeter of the frame.

The optical fibre conductor acts as a sensor and may be integrated into a special covering or directly into the covering of the frame, it being possible in some cases even to reduce the cost of the construction of the covering by incorporating that belonging to the insulating means of the sensor means.

Tests carried out using this new anti-pinching system demonstrate that, when the window to be raised in the door frame by suitable means encounters an obstacle, pressure is exerted on the covering and the sensor, in such a way that the latter reduces the amount of light it transmits, this reduction being analysed by the appropriate electronic systems provided with sufficient memory for comparing a normal light transmission value with a modified value, this comparison being used to interpret that the variation is caused by an obstacle encountered during raising of the window, and the electric motor which actuates raising of the window is then commanded to stop, after which rotation of the motor may be reversed, resulting in lowering of the window.

The proposed system combines great simplicity with low cost, by using commercially available components which do not have to be newly designed, and with great ease of manufacture, since it may either be integrated into a special covering or, if necessary, be integrated into any

of the surfaces of the covering of the door frame or the structure thereof.

Implementation of the system and the field and laboratory trials carried out with said system have demonstrated that higher sensitivity values may be obtained for the optical fibre conductor, that is to say a greater improvement of the system with respect to obstacles, by arranging the optical fibre conductor in loops, for which it is necessary to redesign the system in such a way that it includes both a rubber profile, which permits arrangement of said optical fibre in loops, and a new system of sensors which make it possible for the reference value not to have to be stored prior to operation of the system.

The proposed rubber profile, which is located inside the window frame and which is installed inside the seal located in the window frame, is designed in such a way that it comprises a series of incisions which permit arrangement of the optical fibre in undulating form, in such a way that, in said arrangement, said optical fibre protrudes therefrom, and in this way the angle of refraction in the case of deformation increases in magnitude and therefore increases the sensitivity of the system when the latter detects an obstacle, the upper edge of the window deforming said loops.

The incisions formed in the profile for passage of the optical fibre conductor and the arrangement thereof in looped form make it possible that, once positioning has been effected inside by suitable means, they are covered with adhesives or welded to keep covered the areas protected by the sealing profile, in such a way that all this permits wholly automated production.

The above-described profile is included inside the general seal which covers the whole window frame and which is situated at the upper part of the door.

In addition to the different arrangement of the optical fibre described above, another aim of the present invention is to modify the system for detecting obstacles so that it changes the reference value, that is to say the 30 millisecond value relating to the absence of obstacles, prior to raising the window, that is to say at the same moment in which the user presses the button to close the open window the improved system emits a signal for detecting the optical fibre transmission value at that moment, without any type of obstacle being present and before the window even starts its upward movement.

When the window, upon ascent, encounters an obstacle, the latter is pressed by the upward force thereof against the profile and the frame seal, which changes the light conductivity value. The sensor detects from said modification and reduction in transmission that an obstacle is present and causes the motor to stop and reverse its direction of rotation, in such a way that the window descends and releases the obstacle from between the upper edge of the window and the window frame.

Providing an instantaneous value which is not previously stored allows the improved anti-pinching system to which the present invention relates to be independent of the variations in voltage which may occur in the car, that is to say when, for whatever reason, the car finds itself without power, whether because an electric circuit has been cut or because the battery is flat or for any other reason, it is not necessary, as happens with anti-pinching systems of the prior art, to reprogram the anti-pinching system and re-store the reference values so that the system may operate.

Therefore, given that in the systems of the prior art, said reference value differs depending on the model of car since different models exhibit differences with respect to the motor, the window length, the weight, the length of the seals and amount of friction, said improved anti-pinching system may be used in all types of cars and doors, whatever their structure, configuration and length, the weight of the windows and any other variant which a change of car model entails.

The above-described system with the improvements proposed in the present invention may also be used to prevent pinching in doors, the bonnet and the boot, or sunroof of vehicles etc.

Other details and characteristics of the present invention will become clear from a reading of the description given below, which refers to the drawings accompanying this specification and in which the details referred to are shown schematically. These details are given by way of example, referring to one possible practical embodiment which is not limited to those details described here; therefore, this description should be regarded as an illustration, not limiting in any way.

There follows a detailed list of the various elements referred to, (10) door, (11) inner side, (12) frame, (13) frame covering, (14) sensor, (15) sensor covering, (16) electric motor, (17) power source, (18) optical fibre conductor, (19) relay, (20) meter, (21) window, (22) cable, (23) guideway, (24) support, (25) sensor, (26) profile, (27) incisions, (28) mouth, (29) passageway, (30) cavity, (31) optical fibre, (32) end, (33) end, (34) loops.

Figure 1 is a schematic front elevational view of a car door (10) viewed from the inside, including the components are arranged which permit raising and lowering of a window (21);

Figure 2 is a partially cross-sectional elevational view of a frame (12) of a door (10), in which is located the proposed system;

Figure 3 is a front elevational view of the sensor (25) formed by the profile (26) and the optical fibre conductor (31), forming a series of loops (34); and,

Figure 4 is an upper plan view of the profile (26) with the proposed arrangement.

As may be seen in Figure 1, a door (10) takes the form of a sheet which has been duly machined into shape and is provided at its upper part with an appropriate frame (12) which, as may be seen in Figure 2, is covered on the inside with a covering (13) which will contact a window when the latter is raised, in such a way that when pressure is exerted on the upper part of said covering (13) a perfect seal is produced between the outer part and the inner part of the car.

Figure 1 also shows the various components which are conventionally used for raising said window (21), such as an electric motor (16) which is supplied with power by a power source (17), not shown in the Figures, via a cable (22), and a guideway or guideways (23) which allow(s) vertical displacement of a support (24) located at the lower part of the window (21) and which, by means of the above-described components together with others of electrical nature, such as a relay (19) and a meter (20), form a system for detecting and reversing the movement of said window (21) in the frame (12) of the door (10).

In one of the preferred embodiments of the proposed system, the covering of the frame (12) - (13) in turn incorporates another covering (15), which has the sensor (14) incorporated within it.

The sensor (14) takes the form of an optical fibre conductor which extends over the whole length of the frame (12) or part thereof. In particular, the sensor extends over at least those parts of the frame (12) against which the window may otherwise pinch an obstacle, such as a finger. This includes not only the upper part of the frame (12), but also inclined side portions of the frame (12).

Operation of the proposed system is as follows: when the window is raised and lowered by means of the above-described components without any problems, there passes through the inside of the optical fibre conductor a quantity of light determined in accordance with the characteristics of the system and the particular characteristics of the optical fibre conductor, which is detected continuously by an electronic system not shown in the Figures.

When the window encounters any type of obstacle at its upper or side edges and said obstacle is pressed by the vertical ascending action of the window (21) against the covering (13) of the frame (12), the covering (15) of the sensor (14) receives pressure which is transmitted in turn to said conductor, consequently restricting and reducing the conduction and quantity of light, which is determined and detected by suitable electronic means, such as the relay (19), these being programmed to carry out periodic checks such that any variation in the conduction of light will be interpreted to denote the presence of an obstacle.

Similarly, by means of these suitable programming means, any variation in the conduction of light in the conductor may be interpreted as a modification in the environmental conditions, that is to say any damage to the covering (13) or (15) caused by external means, aging or by poorly effected repairs to the door (10) of the car.

Embodiments may be considered equivalent which introduce the presence of an optical fibre conductor not over the entirety of the length of the frame (12) but only over part thereof, better to suit the configuration and characteristics of said frame and car door (10).

In a further embodiment of the present invention, rather than providing the sensor in a wholly lengthwise arrangement, the covering may include a substantially prismatic profile (26), which exhibits regularly spaced incisions (27) as shown in Figure 3.

As may be seen in Figure 4, each incision (12) comprises a mouth (28) which allows the optical fibre conductor (31) to be pressed into position by any known means so that it may slide through the passageway (29) until it (31) is situated in the cavity (30), in such a way that loops (34) are formed, as may be seen in Figure 3, forming a complete circuit, in such a way that the ends of the conductor (31), (32) and (33), may be connected by suitable means to the unit which the system includes for measuring light conductivity.

Once the optical fibre (31) is positioned inside the cavity (30), via the mouth (28) of the passageway (29), any known system is used to position an adhesive or to effect subsequent welding, in such a way that said optical fibre conductor (31), in the form shown in Figure 3, cannot be displaced.

The arrangement of the optical fibre conductor (31) in loops (34) inside the profile (26), see Figure 4, allows easier detection of any pressure thereon which may result from trapping an object between the upper edge of the door frame and the upper edge of the window than when the optical fibre conductor (31) of the main patent is disposed along the frame.

Once the optical fibre conductor (31) has been positioned inside the profile (26), the latter and the incisions (27) are covered with adhesive or welded, so as to be subsequently introduced by suitable means into the internal covering of the frame.

The present invention may also provide an anti-pinching system which dispenses with the need for a reference value stored permanently prior to actuation of the system, that is to say that the anti-pinching system operates between a reference value, which will be that measured in the instant prior to raising the window, and the modified value obtained when said value is modified by the imprisonment of an object between the upper edge of the window and the window frame.

The subject matter of the present Patent has been adequately described, in relation to the attached drawings, and it will be understood that any modifications in detail may be made to the same which are considered advantageous as long as the proposed variations do not alter the essence of the Patent summarized in the following claims.

## CLAIMS

1. An anti-pinching system comprising a light guide disposed along at least part of the perimeter of a frame, a light source for transmitting light along the light guide and a light detector for detecting the intensity of light passing along the light guide, a motor for raising and lowering a movable member within the frame and arranged such that the entrapment of an object between the movable member and the frame will cause a change in the intensity of light detected by the detector to stop or reverse the motor.

2. An anti-pinching system according to Claim 1, in which the light guide consists of an optical fibre conductor.

3. An anti-pinching system according to Claim 1 or Claim 2, in which the light guide is integrated into a covering independent of the covering of the frame.

4. An anti-pinching system according to Claim 1 or 2, in which the light guide is integrated directly in the covering of the frame.

5. An anti-pinching system according to any one of the preceding claims in which the light guide is provided in the form of loops at the points where the light guide enters and exits from a series of incisions formed at regular intervals in the lateral areas of a mounting.

6. An anti-pinching system according to Claim 5, in which the incisions comprise a mouth for insertion of the light guide to a passageway which ends in a cavity, in which the light guide is retained through the application of an appropriate adhesive or by a conventional welding operation.

7. An anti-pinching system according to any one of the preceding claims, in which, approximately 20 to 30 milliseconds prior to raising the movable member in the frame, the system detects the value of the light conductivity of the light guide as a reference value.

8. An anti-pinching system according to Claim 1, in which the motor is stopped or reversed when the detected light intensity differs from the reference value by a predetermined amount.

9. An anti-pinching system according to any one of the preceding claims, in which the movable member is a window.

10. An anti-pinching system substantially as shown in or as described with respect to any of the accompanying drawings.

**Amendments to the claims have been filed as follows**

CLAIMS

1. An anti-pinching system comprising a light guide disposed along at least part of the perimeter of a frame, the light guide being provided in the form of loops at the points where the light guide enters and exits from a series of incisions formed at regular intervals in the lateral areas of a mounting, a light source for transmitting light along the light guide and a light detector for detecting the intensity of light passing along the light guide, a motor for raising and lowering a movable member within the frame and arranged such that the entrapment of an object between the movable member and the frame will cause a change in the intensity of light detected by the detector to stop or reverse the motor.

2. An anti-pinching system according to Claim 1, in which the light guide consists of an optical fibre conductor.

3. An anti-pinching system according to Claim 1 or Claim 2, in which the light guide is integrated into a covering independent of the covering of the frame.

4. An anti-pinching system according to Claim 1 or 2, in which the light guide is integrated directly in the covering of the frame.

5. An anti-pinching system according to any one of the preceding claims, in which the incisions comprise a mouth for insertion of the light guide to a passageway which ends in a cavity, in which the light guide is retained through the application of an appropriate adhesive or by a conventional welding operation.

6. An anti-pinching system according to any one of the preceding claims, in which, approximately 20 to 30 milliseconds prior to raising the movable member in the frame, the system detects the value of the light conductivity of the light guide as a reference value.

7. An anti-pinching system according to Claim 6, in which the motor is stopped or reversed when the detected light intensity differs from the reference value by a predetermined amount.

8. An anti-pinching system according to any one of the preceding claims, in which the movable member is a window.

9. An anti-pinching system substantially as shown in or as described with respect to any of the accompanying drawings.

The Patent Office

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**Application No:** GB 9903413.4 **Examiner:** G WERRETT
**Claims searched:** 1-10 **Date of search:** 11 March 1999

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): E2M.

Int Cl (Ed.6): E05F.

Other: Online : WPI.

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X | GB 2301622 A | (STANDARD) see e.g. p. 2, l. 33 on. | 1. |
| X | GB 2288014 A | (STANDARD) see e.g. p. 5, l. 22 on. | 1. |
| X | US 5326967 | (HERRMANN) see e.g. Col. 2, l. 45 on. | 1. |

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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